Claims

[c1] 1. A method of image binarization using histogram modeling, comprising the steps of:

from a source having foreground and background luminance areas, obtaining a gray scale digital input image comprising a plurality of pixels having respective gray scale values corresponding to the average intensity of the gray scale digital input image over a particular pixel location;

creating a higher spatial resolution gray scale image comprising a plurality of *p x q* arrays of pixels, one of each of said *p x q* arrays for each of the pixels in said gray scale digital input image, with the gray scale values of each of said pixels in each of said *p x q* arrays of pixels calculated from the gray scale values of the pixels of said gray scale digital input image;

creating a higher spatial resolution binary image comprising a plurality of *p x q* arrays of pixels, one of each of said *p x q* arrays for each of the pixels in said gray scale digital input image, with each pixel in each of said *p x q* arrays in said higher spatial resolution binary image having a binary value representing foreground or background;

creating (p x q + 1) classes of number m, where m is the possible numbers of pixels in each of said *p x q* array of pixels in said higher spatial resolution binary image having a binary value representing foreground;

creating a histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image;

modeling said histogram with (p x q + 1) functions, labeled function m, such that said function m of each of said functions models the portion of said histogram contributed by pixels from said gray scale digital input image having gray scale values proportional to the ratio of the source foreground luminance area to the source foreground luminance area plus the source background luminance area, in the corresponding particular pixel location, of m / (p x q);

assigning each of said plurality of gray scale digital input image pixel values to one of said classes, such that the said gray scale digital input image pixel value is most likely to belong to the portion of said histogram modeled by the corresponding function; and

for each of said *p x q* array of pixels in said higher spatial resolution binary

image, setting n pixels to foreground, where n is the class assigned the corresponding gray scale digital input image pixel, and the particular n pixels are determined using the corresponding *p x q* array in the higher spatial resolution gray scale image.

[c2] 2. The method of claim 1 further comprising the step of transforming a color image into a gray scale digital input image.

[c3] 3. The method of claim 1 wherein said step of creating a higher spatial resolution gray scale image comprising a plurality of *p x q* arrays of pixels, one of each of said *p x q* arrays for each of the pixels in said gray scale digital input image, with the gray scale values of each of said pixels in each of said *p x q* arrays of pixels calculated from the gray scale values of the pixels of said gray scale digital input image uses the values of the neighboring pixels in said gray scale digital input image when calculating the gray scale values of each of said pixels in each of said *p x q* arrays of pixels.

[c4] 4. The method of claim 1 wherein said step of creating a higher spatial resolution gray scale image comprising a plurality of *p x q* arrays of pixels, one of each of said *p x q* arrays for each of the pixels in said gray scale digital input image, with the gray scale values of each of said pixels in each of said *p x q* arrays of pixels calculated from the gray scale values of the pixels of said gray scale digital input image uses the values of other pixels in said gray scale digital input image when calculating the gray scale values of each of said pixels in each of said *p x q* arrays of pixels.

[c5] 5. The method of claim 4 wherein said step of calculating the gray scale values of each of said pixels in each of said *p x q* arrays of pixels uses linear predictors.

[c6] 6. The method of claim 4 wherein said step of calculating the gray scale values of each of said pixels in each of said *p x q* arrays of pixels uses linear interpolation.

[c7] 7. The method of claim 4 wherein said step of calculating the gray scale values of each of said pixels in each of said *p x q* arrays of pixels uses spline

interpolation.

[c8] 8. The method of claim 1 wherein said step of creating a histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image uses the values for all of said pixels in the plurality of pixels in said gray scale digital input image.

[c9] 9. The method of claim 1 wherein said step of creating a histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image uses the values of said pixels in the plurality of pixels in part of said gray scale digital input image.

[c10] 10. The method of claim 1 wherein said functions are comprised of Gaussian functions.

[c11] 11. The method of claim 1 wherein said step of modeling said histogram with (p x q + 1) functions further comprises the step of minimizing the difference between the sum of all of said functions and the histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image.

[c12] 12. The method of claim 1 wherein said step of creating a histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image uses a range of input gray scale values for each value in the histogram.

[c13] 13. The method of claim 1 wherein said step of:
creating a higher spatial resolution gray scale image comprising a plurality of *p x q* arrays of pixels, one of each of said *p x q* arrays for each of the pixels in said gray scale digital input image, with the gray scale values of each of said pixels in each of said *p x q* arrays of pixels calculated from the gray scale values of the pixels of said gray scale digital input image;
can be accomplished concurrently with said steps of:
creating a histogram of the number of each gray scale value for the plurality of pixels in said gray scale digital input image;
modeling said histogram with (p x q + 1) functions, labeled function m, such

that said function m of each of said functions models the portion of said histogram contributed by pixels from said gray scale digital input image having gray scale values proportional to the ratio of the source foreground luminance area to the source foreground luminance area plus the source background luminance area, in the corresponding particular pixel location, of m / (p x q); and

assigning each of said plurality of gray scale digital input image pixel values to one of said classes, such that the said gray scale digital input image pixel value is most likely to belong to the portion of said histogram modeled by the corresponding function.